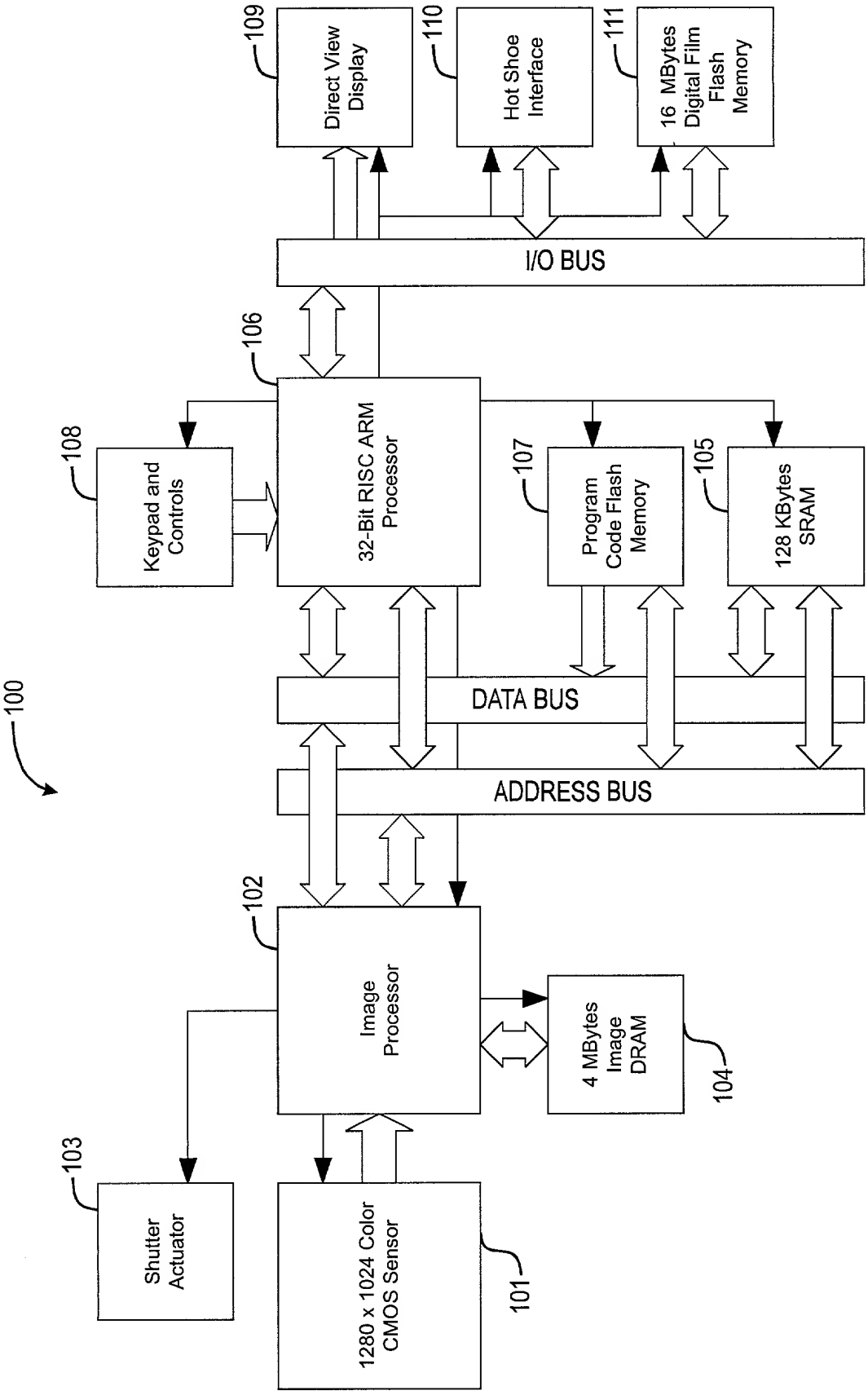
100
101
102
103
104
105
106
107
108
109
110
111
Direct View Display
Hot Shoe Interface
16 MBytes Digital Film Flash Memory
I/O BUS
32-Bit RISC ARM Processor
Keypad and Controls
Program Code Flash Memory
128 KBytes SRAM
DATA BUS
ADDRESS BUS
Image Processor
4 MBytes Image DRAM
Shutter Actuator
1280 x 1024 Color CMOS Sensor

FIG. 1A

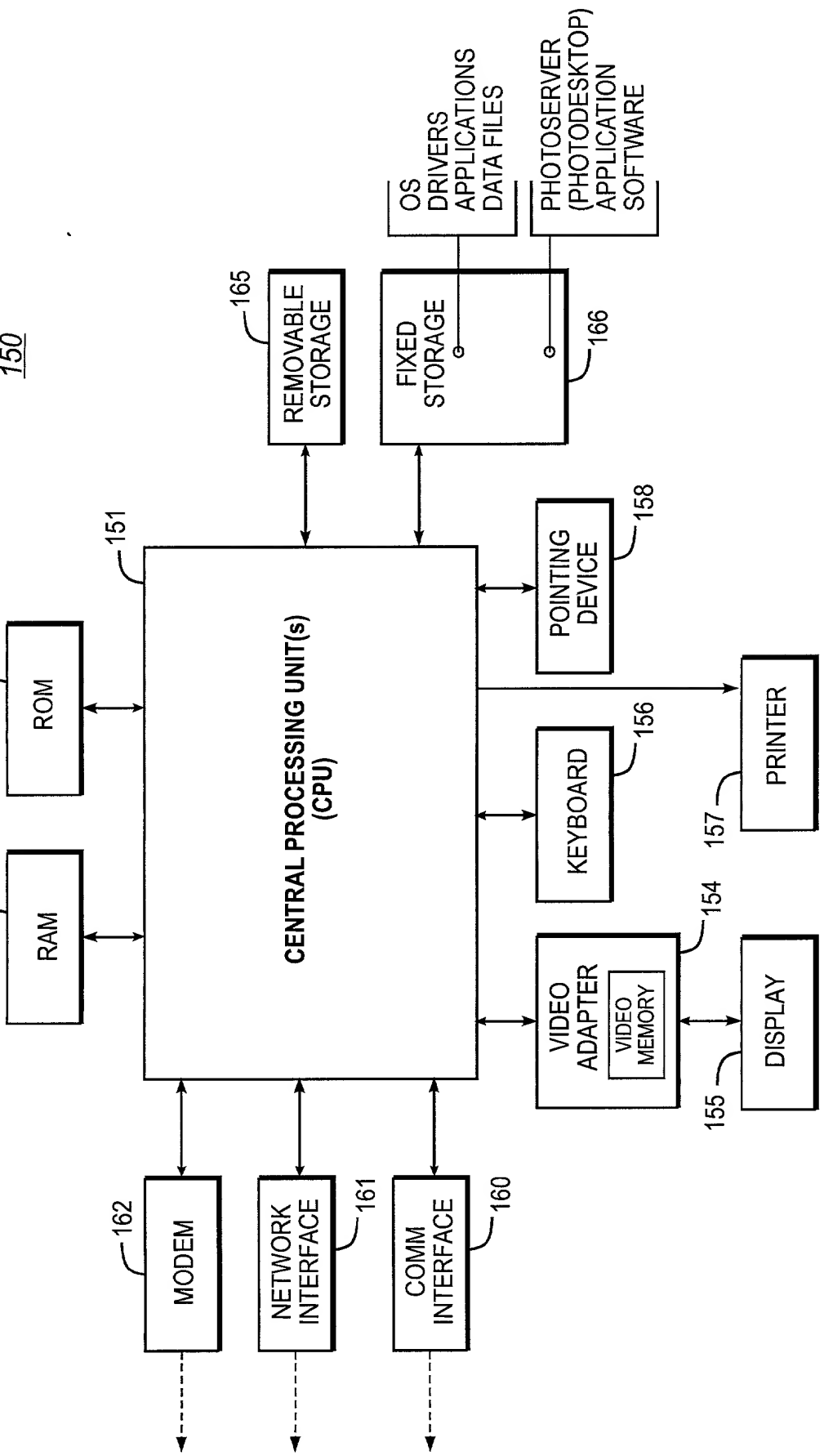
150
CENTRAL PROCESSING UNIT(s) (CPU)
151
ROM
153
RAM
152
REMOVABLE STORAGE
165
FIXED STORAGE
166
OS
DRIVERS
APPLICATIONS
DATA FILES
PHOTOSERVER (PHOTODESKTOP) APPLICATION SOFTWARE
POINTING DEVICE
158
KEYBOARD
156
PRINTER
157
VIDEO ADAPTER
VIDEO MEMORY
154
DISPLAY
155
MODEM
162
NETWORK INTERFACE
161
COMM INTERFACE
160

FIG. 1B

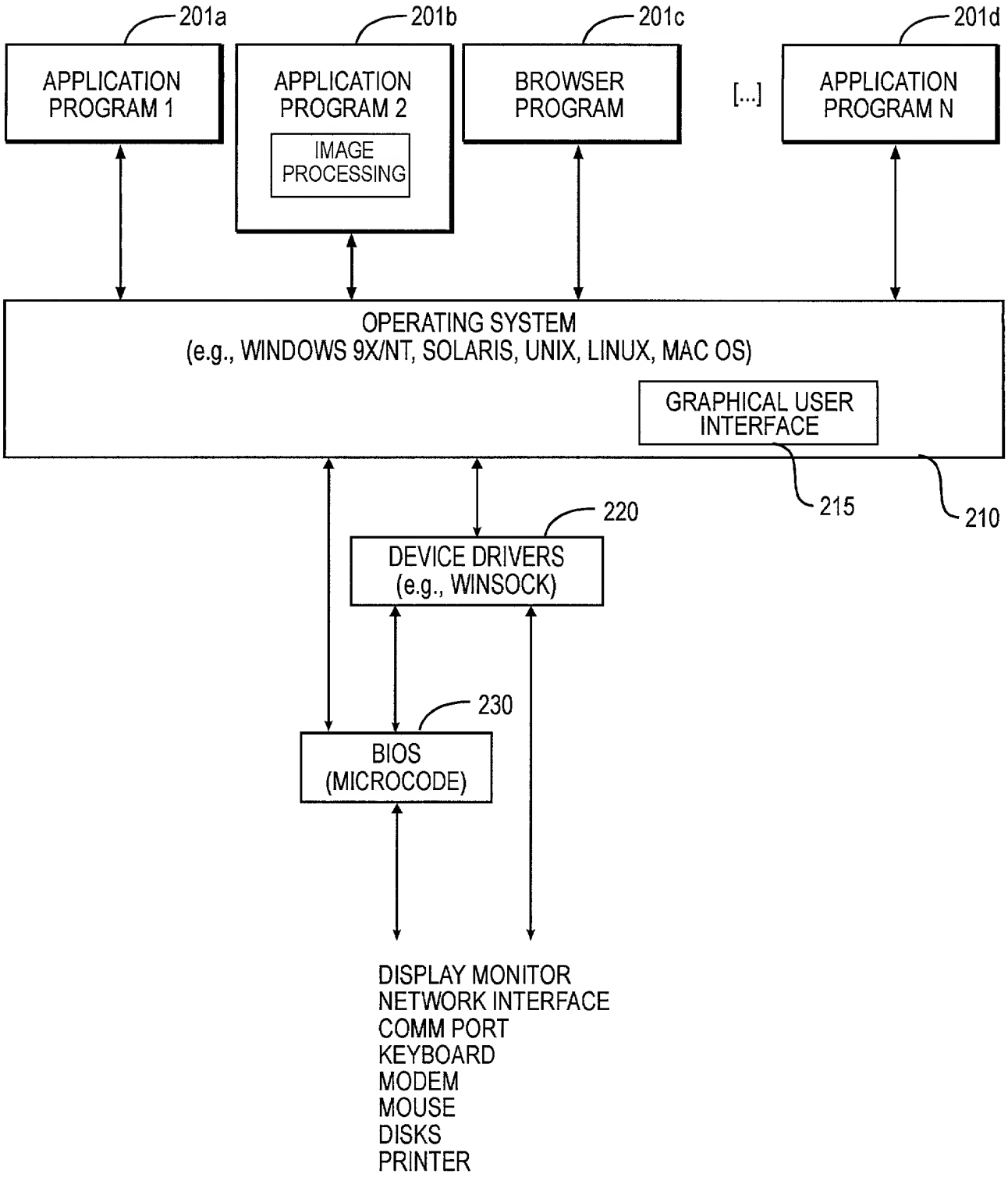
200
201a
APPLICATION PROGRAM 1
201b
APPLICATION PROGRAM 2
IMAGE PROCESSING
201c
BROWSER PROGRAM
[...]
201d
APPLICATION PROGRAM N
OPERATING SYSTEM
(e.g., WINDOWS 9X/NT, SOLARIS, UNIX, LINUX, MAC OS)
GRAPHICAL USER INTERFACE
215
210
220
DEVICE DRIVERS
(e.g., WINSOCK)
230
BIOS
(MICROCODE)
DISPLAY MONITOR
NETWORK INTERFACE
COMM PORT
KEYBOARD
MODEM
MOUSE
DISKS
PRINTER

FIG. 2

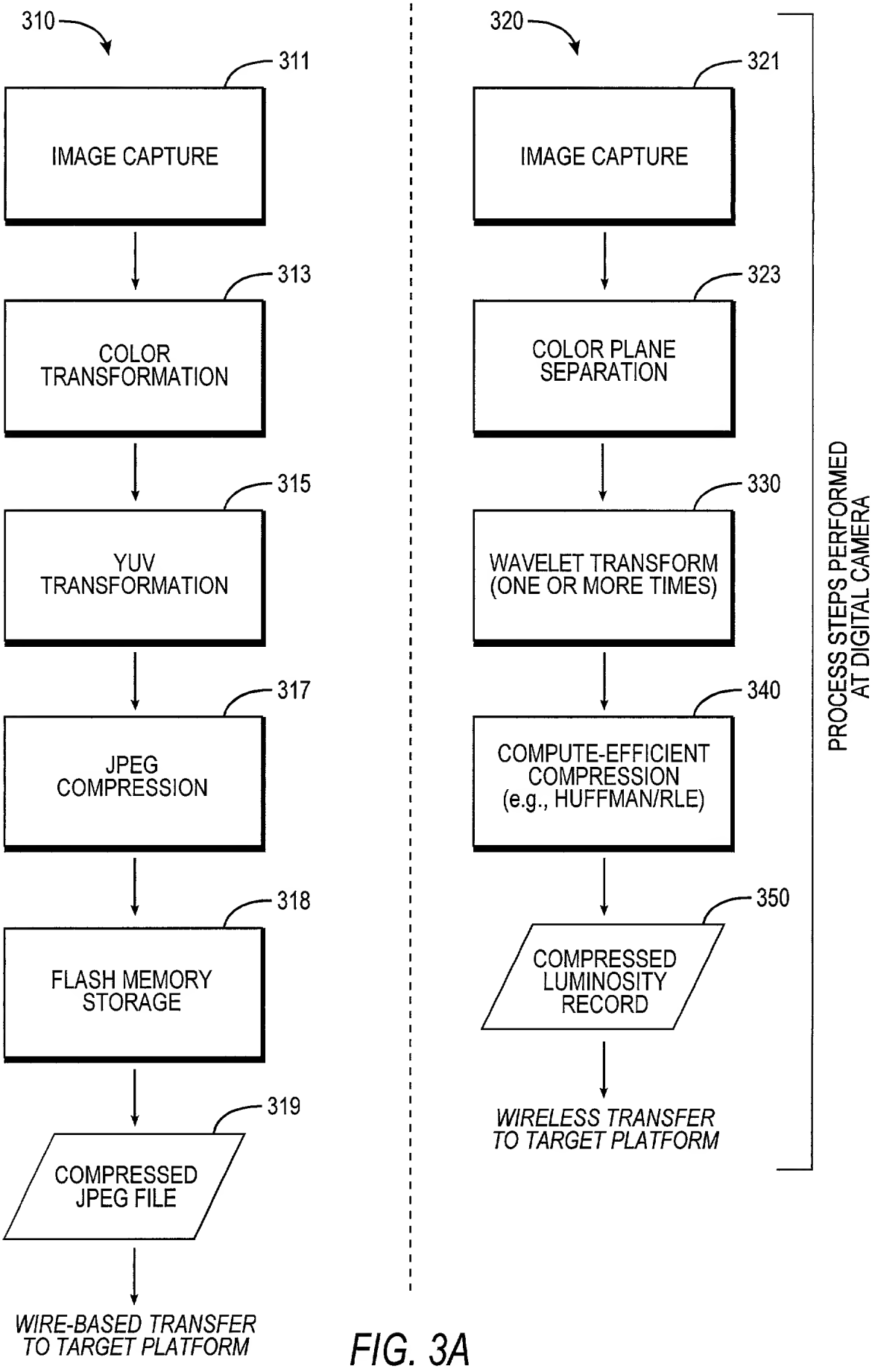
310
311
IMAGE CAPTURE
313
COLOR TRANSFORMATION
315
YUV TRANSFORMATION
317
JPEG COMPRESSION
318
FLASH MEMORY STORAGE
319
COMPRESSED JPEG FILE
WIRE-BASED TRANSFER TO TARGET PLATFORM
320
321
IMAGE CAPTURE
323
COLOR PLANE SEPARATION
330
WAVELET TRANSFORM (ONE OR MORE TIMES)
340
COMPUTE-EFFICIENT COMPRESSION (e.g., HUFFMAN/RLE)
350
COMPRESSED LUMINOSITY RECORD
WIRELESS TRANSFER TO TARGET PLATFORM
PROCESS STEPS PERFORMED AT DIGITAL CAMERA

FIG. 3A

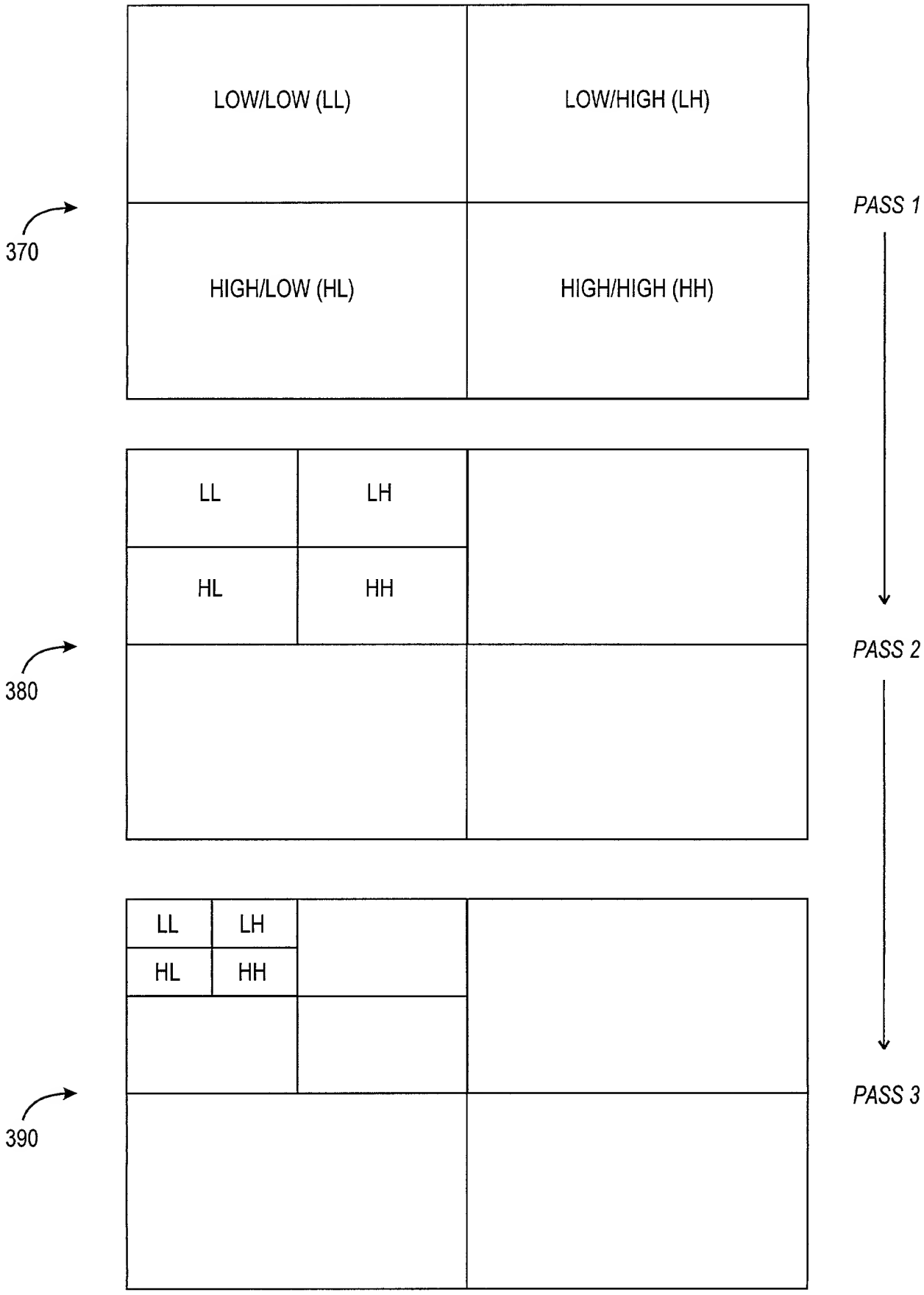
LOW/LOW (LL)
LOW/HIGH (LH)
HIGH/LOW (HL)
HIGH/HIGH (HH)
370
PASS 1
LL
LH
HL
HH
380
PASS 2
LL
LH
HL
HH
390
PASS 3

FIG. 3B

FIG. 3C

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JPEG COMPRESSION (48:1)

FIG. 3D

WAVELET TRANSFORM COMPRESSION (48:1)

FIG. 3E

JPEG COMPRESSION (32:1)

FIG. 3F

WAVELET TRANSFORM COMPRESSION (32:1)

FIG. 3G

Docket # 60074.0004

JPEG COMPRESSION (16:1)

FIG. 3H

WAVELET TRANSFORM COMPRESSION (16:1)

FIG. 3I

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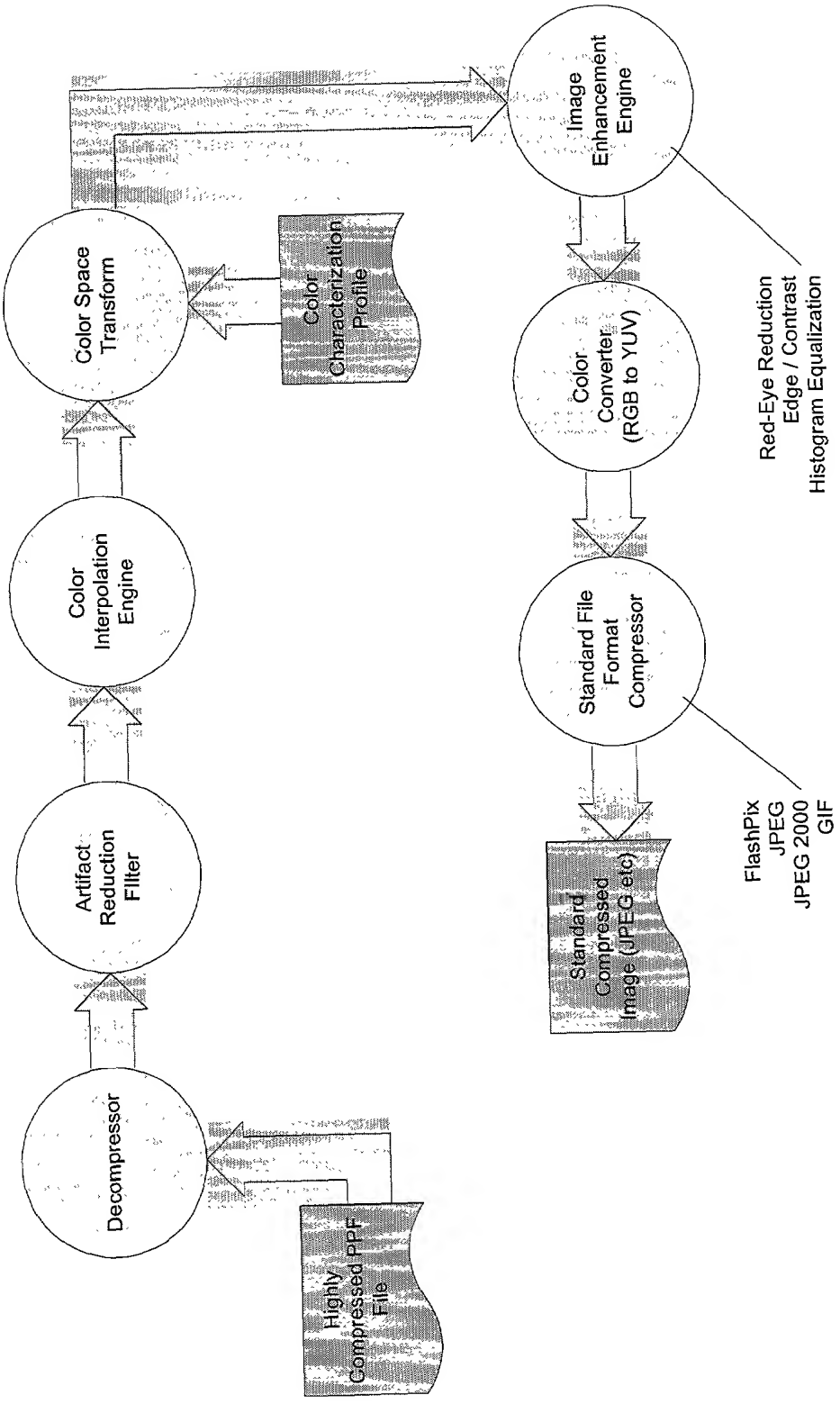
Highly Compressed PPF File
Decompressor
Artifact Reduction FIlter
Color Interpolation Engine
Color Space Transform
Color Characterization Profile
Image Enhancement Engine
Color Converter (RGB to YUV)
Standard File Format Compressor
Standard Compressed Image (JPEG etc)
Red-Eye Reduction
Edge / Contrast
Histogram Equalization
FlashPix
JPEG
JPEG 2000
GIF

FIG. 4A

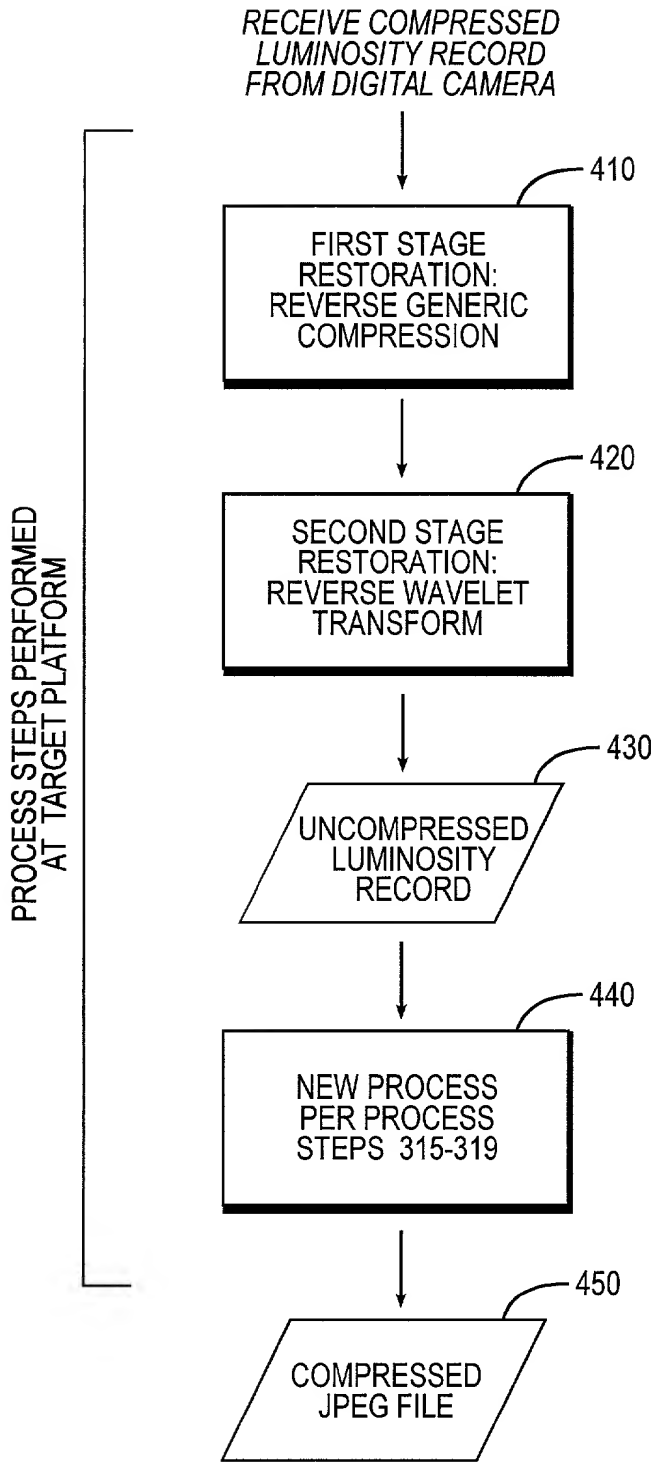
RECEIVE COMPRESSED LUMINOSITY RECORD FROM DIGITAL CAMERA
PROCESS STEPS PERFORMED AT TARGET PLATFORM
410
FIRST STAGE RESTORATION: REVERSE GENERIC COMPRESSION
420
SECOND STAGE RESTORATION: REVERSE WAVELET TRANSFORM
430
UNCOMPRESSED LUMINOSITY RECORD
440
NEW PROCESS PER PROCESS STEPS 315-319
450
COMPRESSED JPEG FILE

FIG. 4B

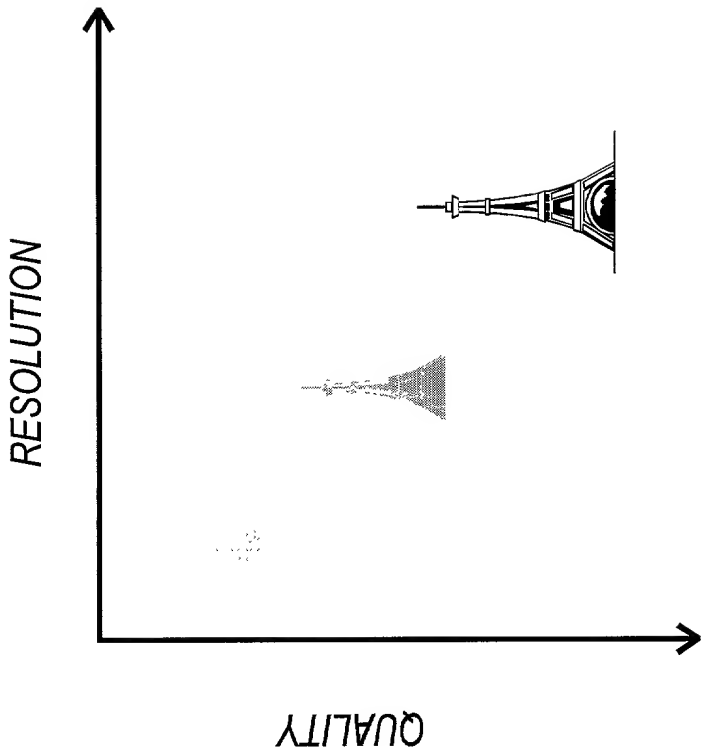

FIG. 5A

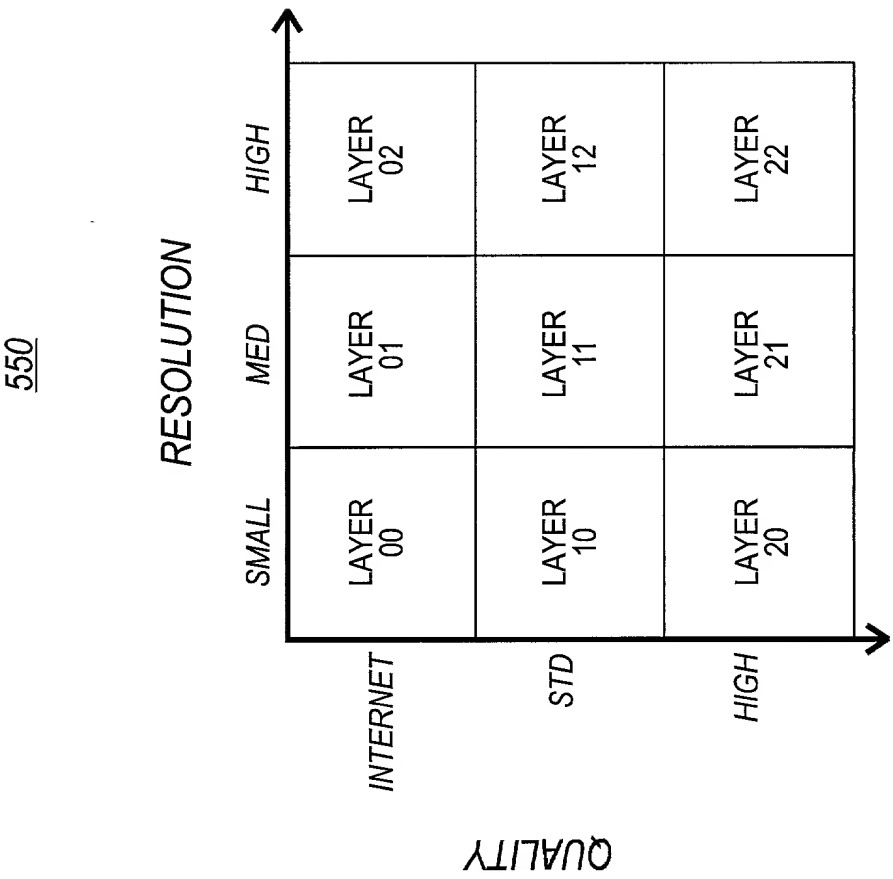
550
RESOLUTION
SMALL
MED
HIGH
LAYER 00
LAYER 01
LAYER 02
LAYER 10
LAYER 11
LAYER 12
LAYER 20
LAYER 21
LAYER 22
INTERNET
STD
HIGH
QUALITY

FIG. 5B

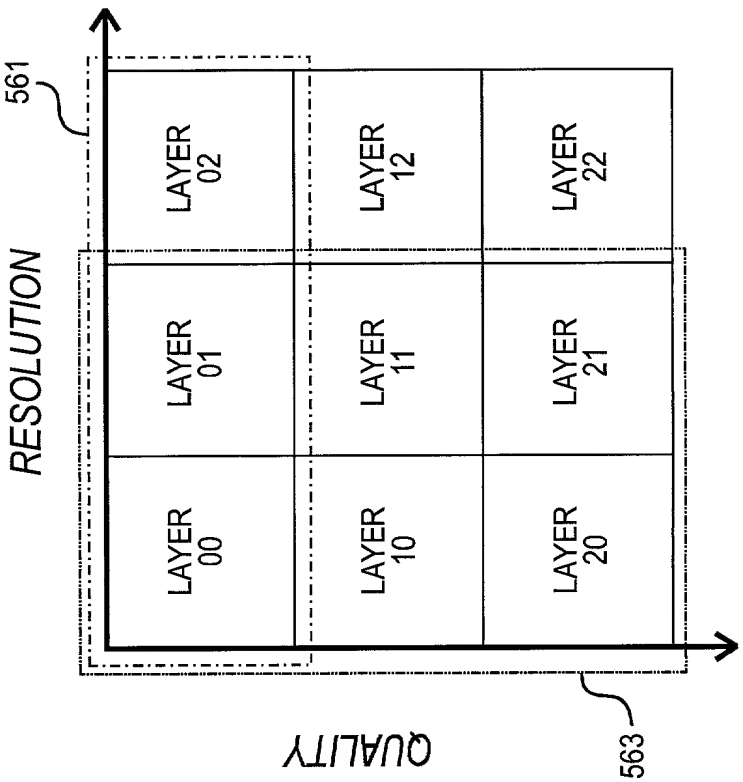
561
RESOLUTION
LAYER 02
LAYER 12
LAYER 22
LAYER 01
LAYER 11
LAYER 21
LAYER 00
LAYER 10
LAYER 20
QUALITY
563

FIG. 5C

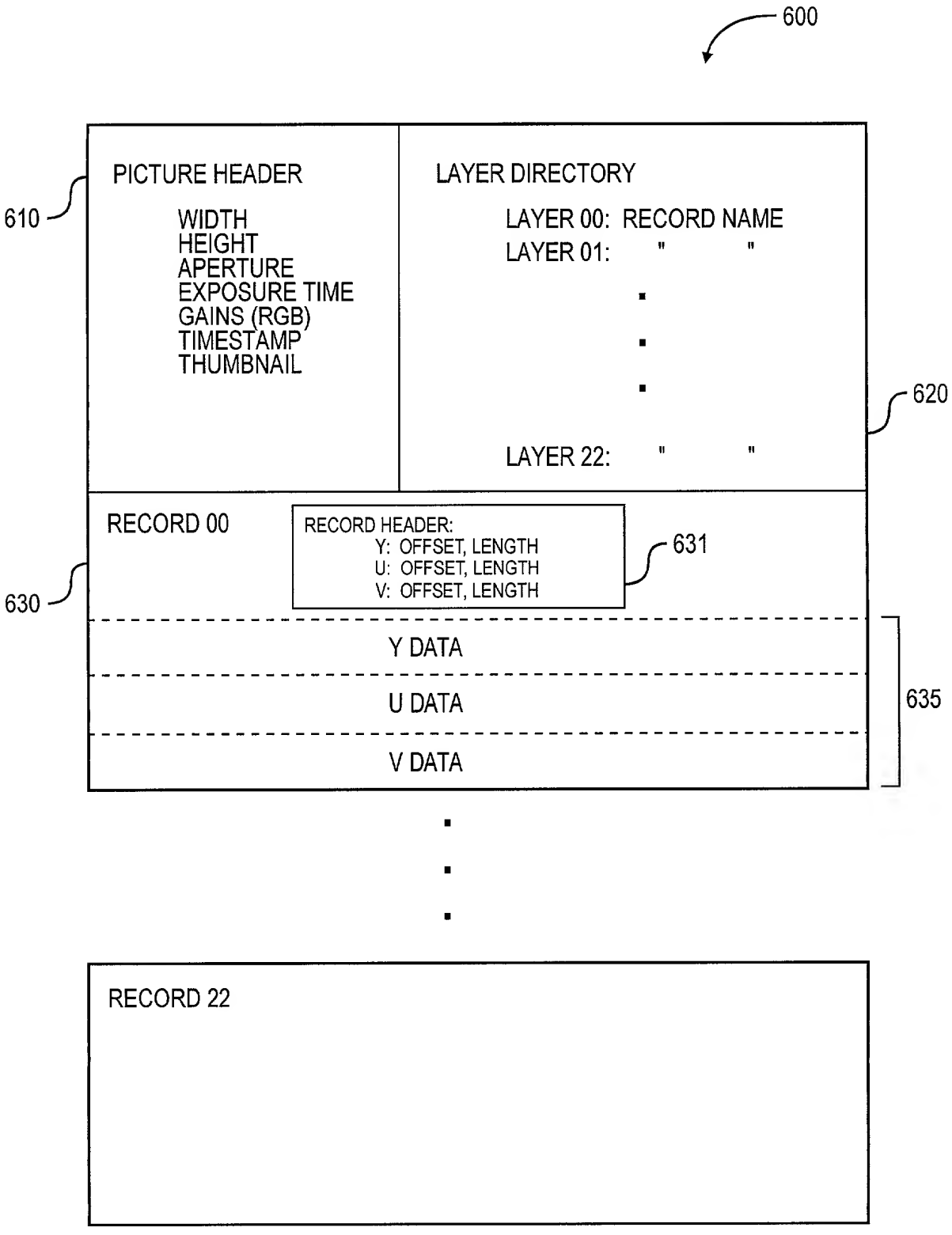
600
PICTURE HEADER
WIDTH
HEIGHT
APERTURE
EXPOSURE TIME
GAINS (RGB)
TIMESTAMP
THUMBNAIL
610
LAYER DIRECTORY
LAYER 00: RECORD NAME
LAYER 01: " "
LAYER 22: " "
620
RECORD 00
RECORD HEADER:
Y: OFFSET, LENGTH
U: OFFSET, LENGTH
V: OFFSET, LENGTH
631
630
Y DATA
U DATA
V DATA
635
RECORD 22

FIG. 6A

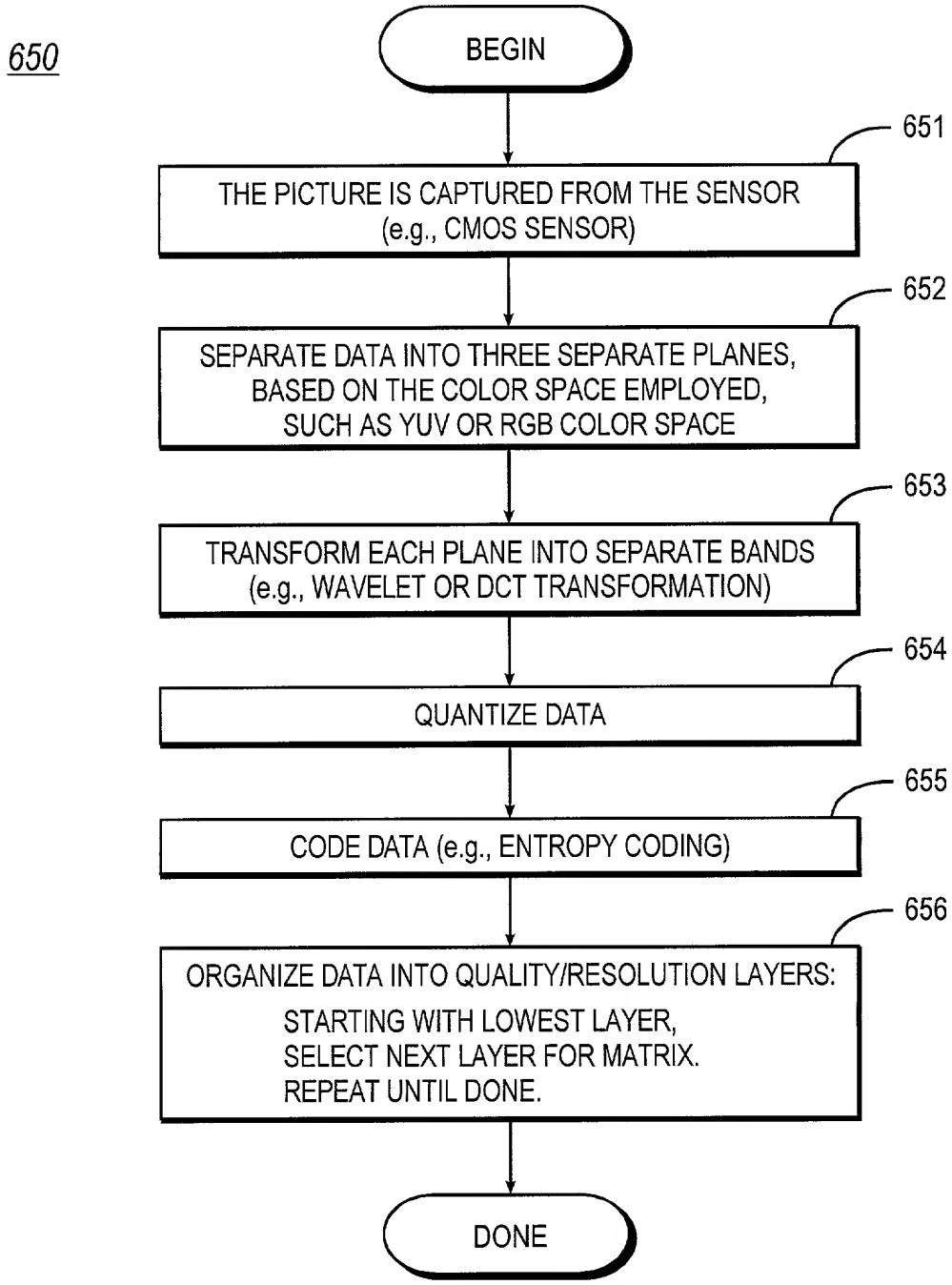
650
BEGIN
651
THE PICTURE IS CAPTURED FROM THE SENSOR
(e.g., CMOS SENSOR)
652
SEPARATE DATA INTO THREE SEPARATE PLANES,
BASED ON THE COLOR SPACE EMPLOYED,
SUCH AS YUV OR RGB COLOR SPACE
653
TRANSFORM EACH PLANE INTO SEPARATE BANDS
(e.g., WAVELET OR DCT TRANSFORMATION)
654
QUANTIZE DATA
655
CODE DATA (e.g., ENTROPY CODING)
656
ORGANIZE DATA INTO QUALITY/RESOLUTION LAYERS:
STARTING WITH LOWEST LAYER,
SELECT NEXT LAYER FOR MATRIX.
REPEAT UNTIL DONE.
DONE

FIG. 6B

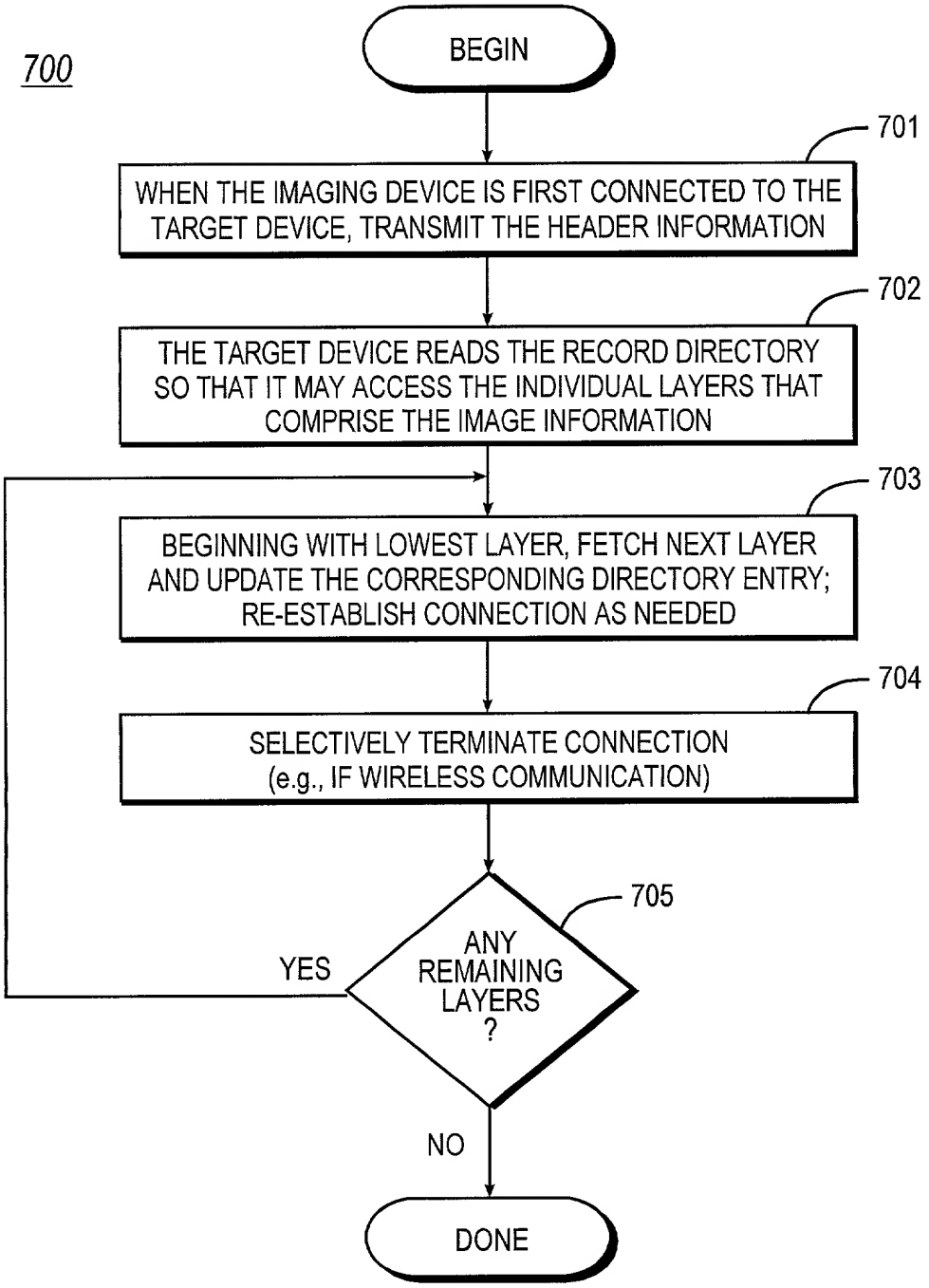
700
BEGIN
701
WHEN THE IMAGING DEVICE IS FIRST CONNECTED TO THE TARGET DEVICE, TRANSMIT THE HEADER INFORMATION
702
THE TARGET DEVICE READS THE RECORD DIRECTORY SO THAT IT MAY ACCESS THE INDIVIDUAL LAYERS THAT COMPRISE THE IMAGE INFORMATION
703
BEGINNING WITH LOWEST LAYER, FETCH NEXT LAYER AND UPDATE THE CORRESPONDING DIRECTORY ENTRY; RE-ESTABLISH CONNECTION AS NEEDED
704
SELECTIVELY TERMINATE CONNECTION (e.g., IF WIRELESS COMMUNICATION)
705
ANY REMAINING LAYERS ?
YES
NO
DONE

FIG. 7

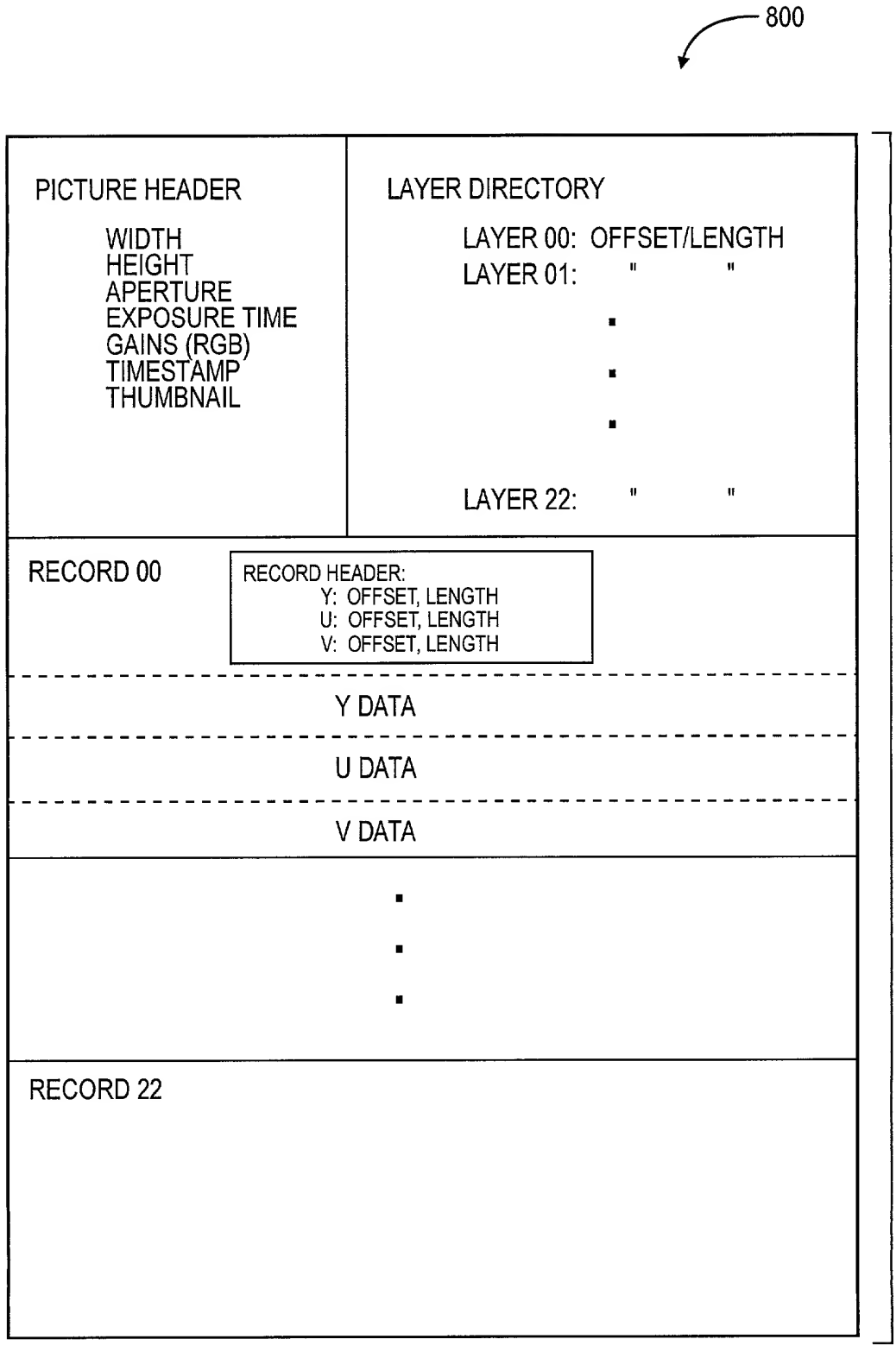
800
PICTURE HEADER
WIDTH
HEIGHT
APERTURE
EXPOSURE TIME
GAINS (RGB)
TIMESTAMP
THUMBNAIL
LAYER DIRECTORY
LAYER 00: OFFSET/LENGTH
LAYER 01: " "
LAYER 22: " "
RECORD 00
RECORD HEADER:
Y: OFFSET, LENGTH
U: OFFSET, LENGTH
V: OFFSET, LENGTH
Y DATA
U DATA
V DATA
RECORD 22
SINGLE BLOB

FIG. 8

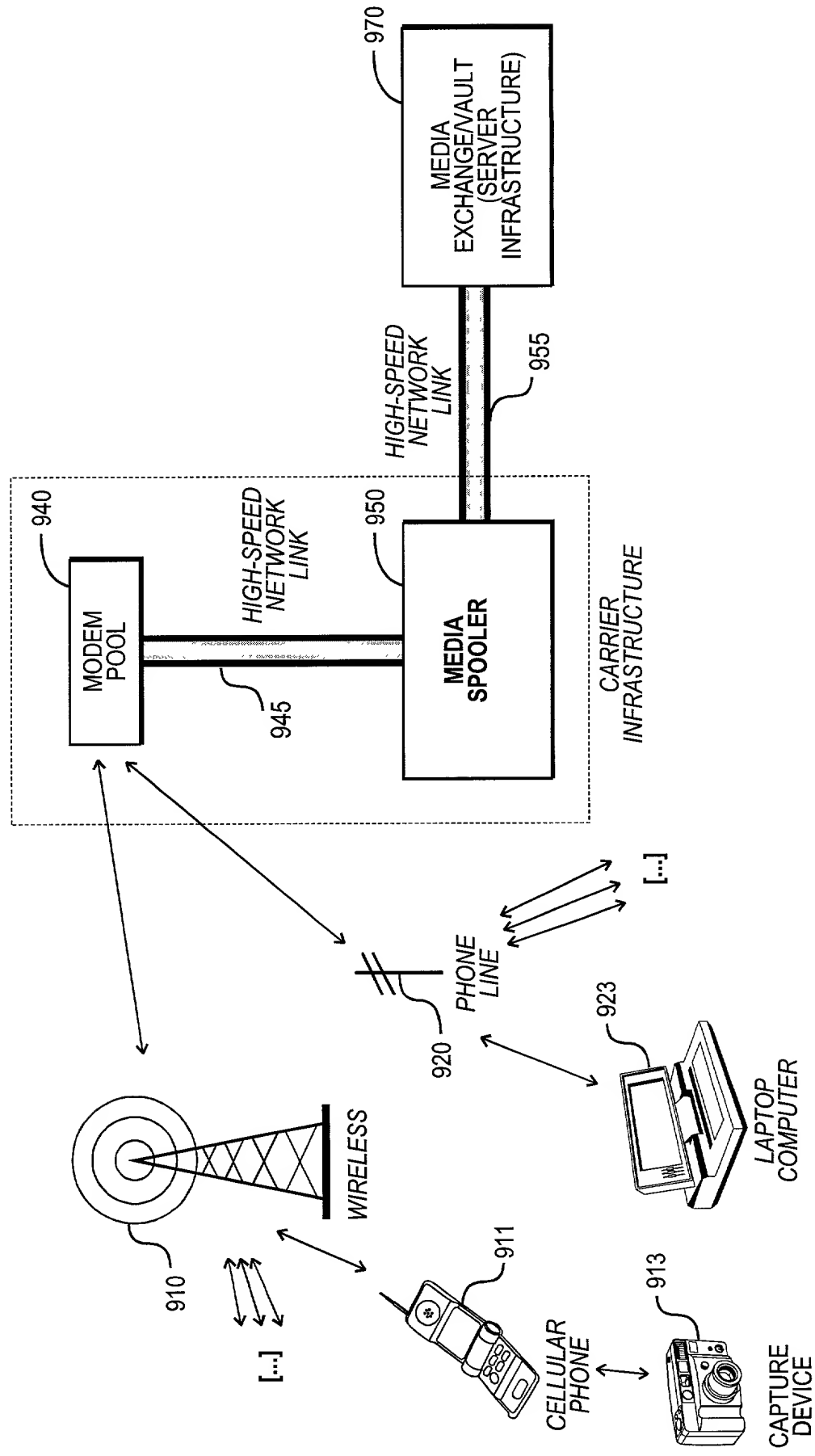
900
970
MEDIA EXCHANGE/VAULT (SERVER INFRASTRUCTURE)
HIGH-SPEED NETWORK LINK
955
940
MODEM POOL
HIGH-SPEED NETWORK LINK
945
950
MEDIA SPOOLER
CARRIER INFRASTRUCTURE
PHONE LINE
920
923
LAPTOP COMPUTER
[...]
WIRELESS
910
911
CELLULAR PHONE
913
CAPTURE DEVICE

FIG. 9

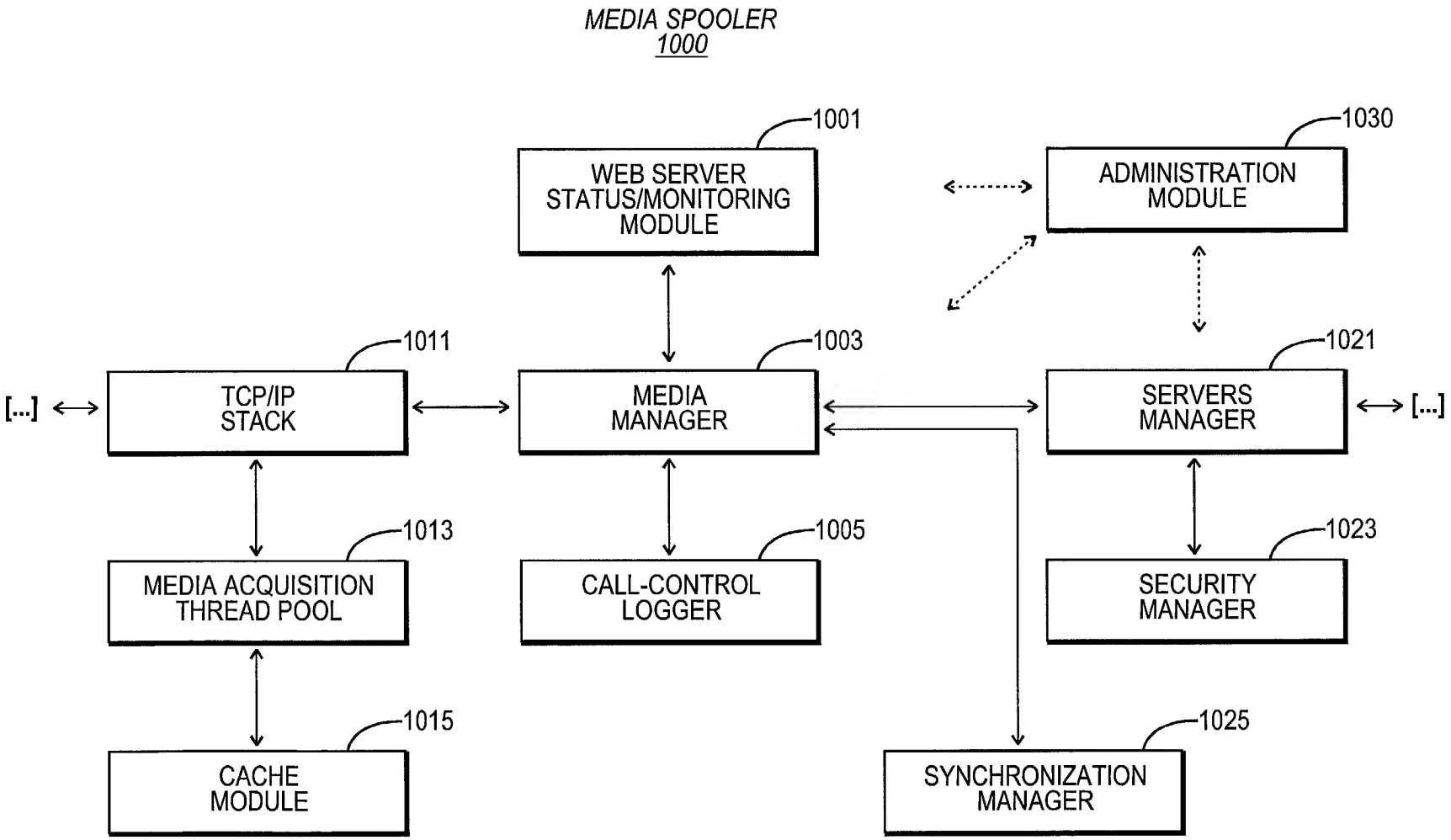

FIG. 10

LIGHTSURF TECHNOLOGIES, INC.
LS/0009.00
SHEET 2 OF 23

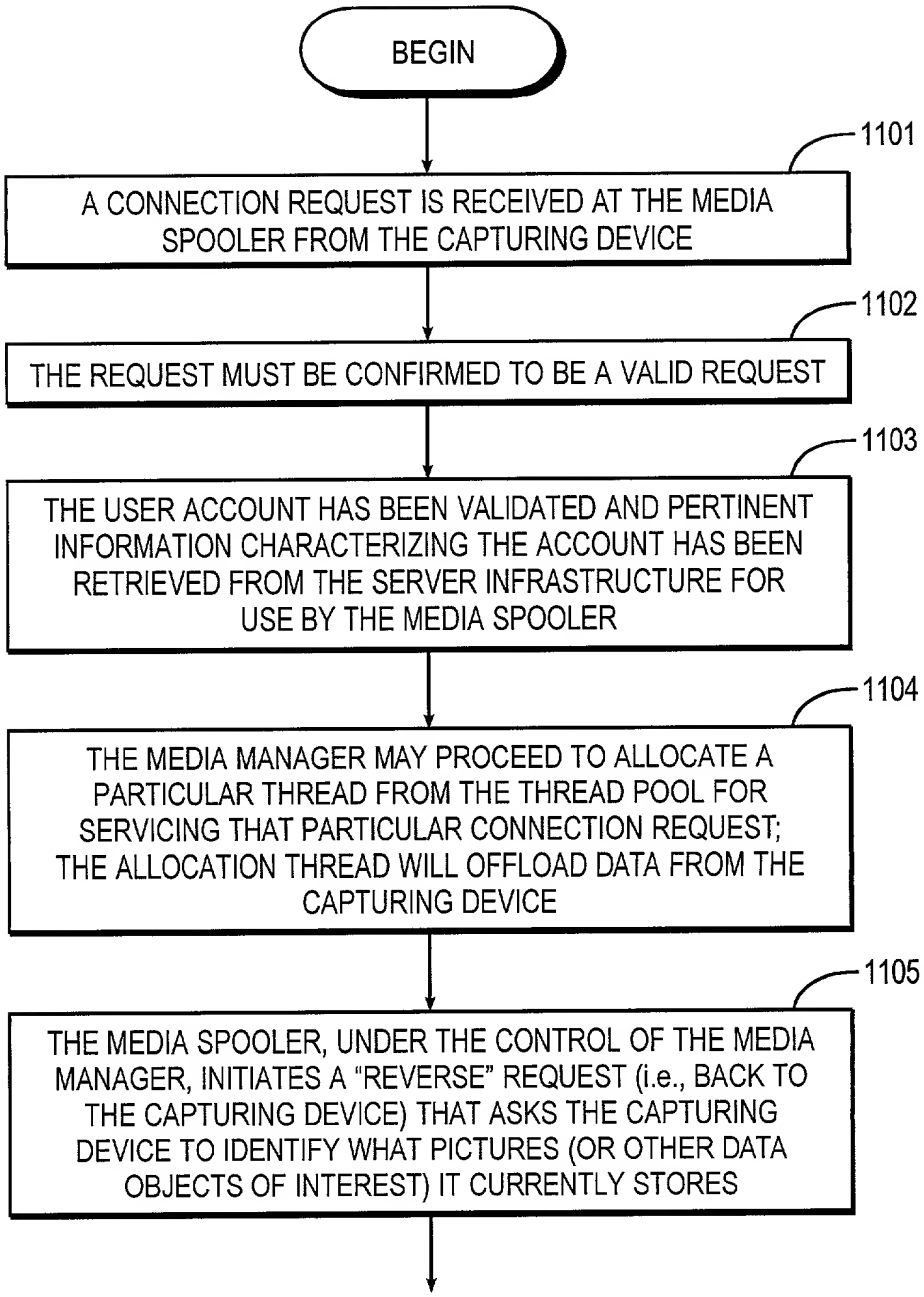
BEGIN
1101
A CONNECTION REQUEST IS RECEIVED AT THE MEDIA SPOOLER FROM THE CAPTURING DEVICE
1102
THE REQUEST MUST BE CONFIRMED TO BE A VALID REQUEST
1103
THE USER ACCOUNT HAS BEEN VALIDATED AND PERTINENT INFORMATION CHARACTERIZING THE ACCOUNT HAS BEEN RETRIEVED FROM THE SERVER INFRASTRUCTURE FOR USE BY THE MEDIA SPOOLER
1104
THE MEDIA MANAGER MAY PROCEED TO ALLOCATE A PARTICULAR THREAD FROM THE THREAD POOL FOR SERVICING THAT PARTICULAR CONNECTION REQUEST; THE ALLOCATION THREAD WILL OFFLOAD DATA FROM THE CAPTURING DEVICE
1105
THE MEDIA SPOOLER, UNDER THE CONTROL OF THE MEDIA MANAGER, INITIATES A "REVERSE" REQUEST (i.e., BACK TO THE CAPTURING DEVICE) THAT ASKS THE CAPTURING DEVICE TO IDENTIFY WHAT PICTURES (OR OTHER DATA OBJECTS OF INTEREST) IT CURRENTLY STORES
CONTINUE TO FIG. 11B

FIG. 11A

CONTINUED FROM FIG. 11A

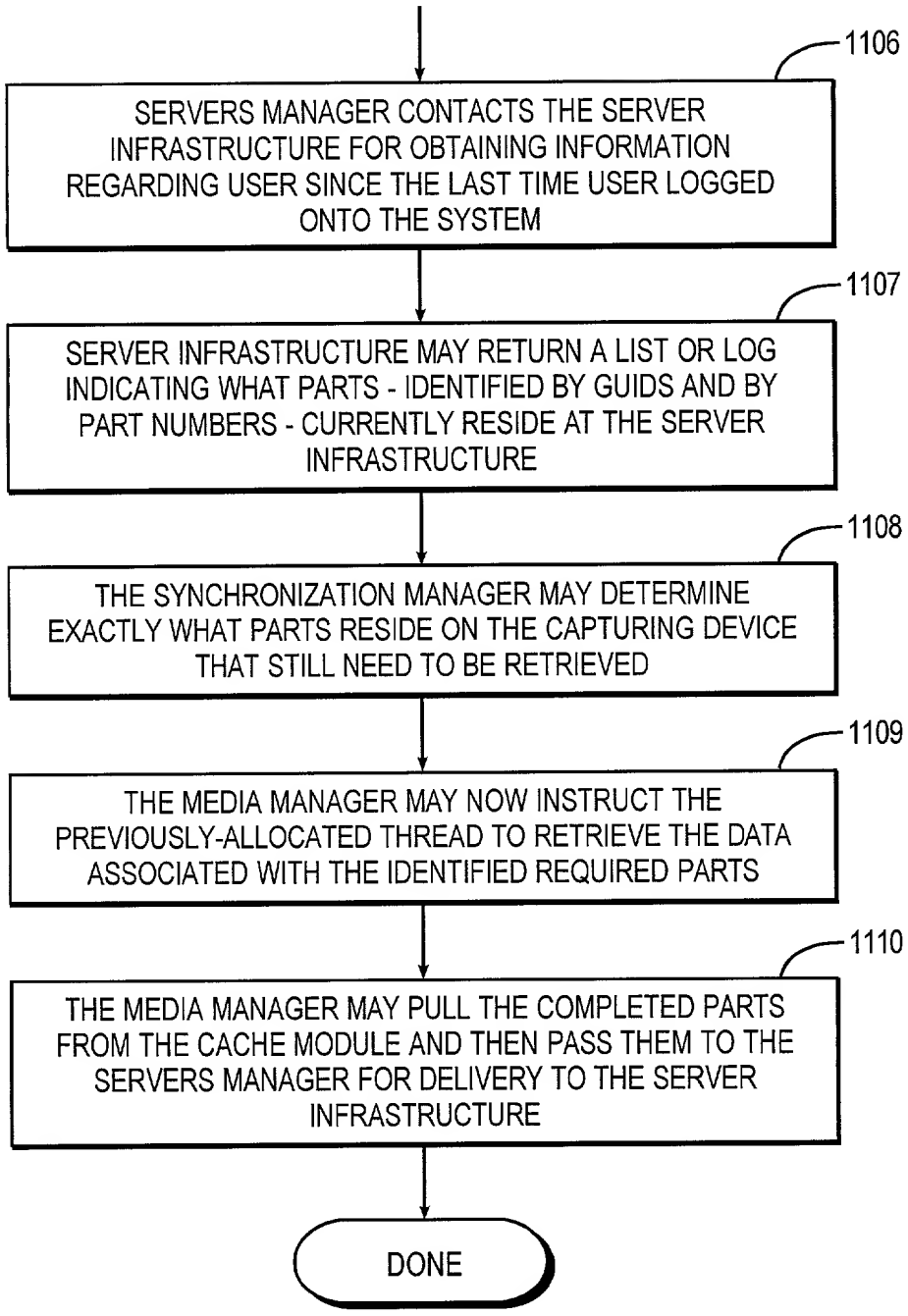

FIG. 11B

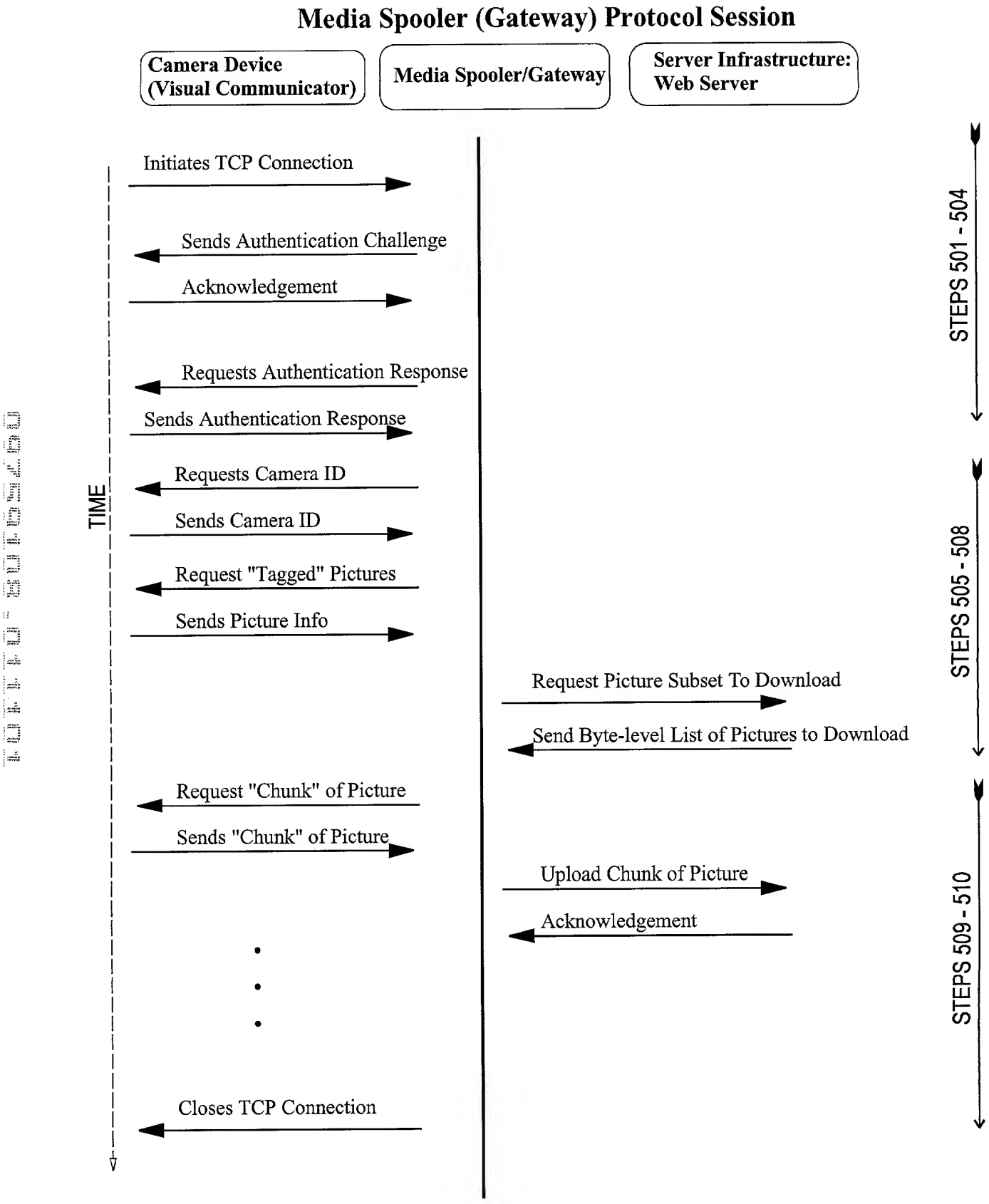
Media Spooler (Gateway) Protocol Session
Camera Device (Visual Communicator)
Media Spooler/Gateway
Server Infrastructure: Web Server
TIME
Initiates TCP Connection
Sends Authentication Challenge
Acknowledgement
Requests Authentication Response
Sends Authentication Response
Requests Camera ID
Sends Camera ID
Request "Tagged" Pictures
Sends Picture Info
Request Picture Subset To Download
Send Byte-level List of Pictures to Download
Request "Chunk" of Picture
Sends "Chunk" of Picture
Upload Chunk of Picture
Acknowledgement
Closes TCP Connection
STEPS 501 - 504
STEPS 505 - 508
STEPS 509 - 510

FIG. 11C